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THE BALTIMORE MEETING.

BALTIMORE, Md., October 16th, 1889.—The first day's session of the Baltimore meeting has been "made into history" by official stenographer Davis, and preliminary to some random notes on the record so made, permit me to say that if the second day's proceedings are to equal in interest those of the first, then, indeed, is the Association to be congratulated.

To begin with, the weather was of that delicious sort which nerves to action and soothes to rest—in accordance with one's wish or fancy; and with weather conditions perfect and the activity of the local committee in keeping therewith, the delegates had nothing to do but enjoy themselves and the programme.

So far, the attendance has been hardly up to expectations—not that it is by any means sparse, for a right goodly number answered the roll call and greeted President Slater when that prince of gavel wielders announced that "order was wanted."

With the man from Providence directing affairs, it was perfectly natural to suppose that the Secretary's chair would be filled by its wonted occupant; but I am sorry to add that an attack of cholera morbus kept Mr. Humphreys in bed pretty much all day. His trying and laborious position was filled by Capt. White, who seems to be the man-in-the-gap at all times; and it is needless to add that no duty was neglected by the "impressed."

One curious circumstance was noticed by many, who in comparing notes seemed to be inclined to the view that the Association was fast becoming a collection of cripples—that is, many appeared to be halting. McElroy, Dickey and others, who were wont to pride themselves on their pedestrian capacities, are now, perforce, willing to take it easy.

To cease these desultory and rambling sentences, let me come to business, and say that the first day's proceedings were interesting and valuable.

Mr. Slater, as was certain to be the case, made an admirable director, and his address was what might be expected from him. I cannot do it justice in these random jottings, but it will easily do that for itself later on, when the types have placed it before your readers.

The paper list was carried out without a break; so far, four have been disposed of.

These were read in the following order:

"Leakage and Condensation," by E. C. Jones.

"Fuel Gas," by Walton Clark.

"Purification of Gas from Kansas Coals," by B. E. Chollar.

"Some Thoughts on Fuel Gas, Induced from Practical Experience in the Distribution of Natural Gas," by John Young.

The papers were well received, but I think the discussion on Mr. Clark's paper serves to prove that, practically, fuel gas exists at present more as a basis for speculation than on any sounder ground. In other words, the only people who seem to note that real progress is being made in the direction of fuel gas are those who are "speculating" or trafficking in it.

The officers chosen are:

President—E. McMillin.

First Vice—J. P. Harbison.

Second Vice—W. H. White.
Third Vice—A. E. Boardman.
Secretary and Treasurer—C. J. R. Humphreys.

October 17, 1889.—Gloriously fine weather marks the second day, and the attendance has been largely augmented. Almost every State in the Union is represented, and the muster roll of the Association has been materially added to. The President-elect, Mr. Emerson McMillin, paid a flying visit to the meeting hall—which is a very comfortable room, but not particularly well adapted for the purposes of the gathering—having journeyed on from New York to pay his respects to his fellows for their compliment to him. Secretary Humphreys is also at his desk again. The papers to-day were on a par with those of yesterday, which is just praise.

Arrangements are now in progress for the banquet this evening, and the final details for the outing of to-morrow are being completed. That both are to be enjoyable cannot be gainsaid. The local committee have covered themselves with glory, and it is the general verdict that the arrangements made and carried out for the entertainment of the ladies of the party are perfect and beyond any similar efforts in the history of the Association.

The next meeting of the Association will be held at Savannah, Ga.

* * *

BRIEFLY TOLD.

"Curbstoning" as a Fine Art.—Our current "Item Columns" contain an account of the "coming to grief," in Philadelphia, of an employee of the Municipal Gas Works Bureau of that city, who sought to revive the ancient but dishonorable practice of "curbstoning." Before going further in comment thereon, perhaps it would be as well at the outset to explain that, in the Philadelphia dialect, a "curbstoner" is one who, standing calmly over the gutter's upright, jots down figures in a memorandum book that are supposed to indicate the quantities of gas that have been used by a consumer during a certain period. Of course, the figures so written might, under the above explanation, be in accordance with the meter's face, but when it is further explained that the "curbstoner," preparatory to marking his book, did not look upon the meter in its dusty and dusky resting-place, it will be at once conceded that his presentation partook largely of the element of chance. From all this the reader will likely arrive at the conclusion that "curbstoning" is not a strictly moral operation, and its practice is quite certain to lead to confusion. In any event, confusion followed the latest exemplification of this "lost art" in the Quaker City, although the *Record* quaintly admits that "most of the curbstoning was done at the expense of the consumer." Seriously, however, we are not quite sure that Philadelphia had or has a monopoly of this nefarious practice, which can do more towards discrediting a gas company than any other single thing that might be named. Poor gas occasionally distributed can be explained away, and an imperfect supply is also easily accounted for, but a falsification of the figures showing the number of feet consumed is indefensible and complainable. And this leads to the remark that as a rule, and particularly in our large cities, the men employed as meter readers by the gas companies are underpaid and overworked. Since the meter is the sole arbiter between the company and the consumer, it will not do to commit the task of reading it to men who are either ignorant or slothful; and such men cannot be permanently retained in the service of a company which will strive to exact the greatest amount of such work and pay therefor but the smallest pittance that its servant will accept. Many "business men" in our large communities—keepers of saloons, etc.—are not over-squeamish as to the inducements which they would offer for a "favorable statement" from the meter reader respecting the quantities of gas consumed by them. For instance, the saloon keeper having "sounded his man," invites him to partake of the "hospitalities of the house," and if the reader accepts—well, the road is paved for a future understanding. Of course, we do not for a moment wish to be understood as saying that even a small minority of the meter readers of our large cities are open to such an impeachment, for it gives us pleasure to add that in the main they are reliable, sober and industrious—though underpaid—men. But we also know that—and from personal knowledge of instances both in this city, Brooklyn and Philadelphia—some of the readers have succumbed to temptation. The moral of the whole thing is plain. These men should be well paid, and should not be called on to perform more than a fair share of work. One other striking fact in connection with the complaints that arise from supposed or real overcharges for gas is to be found in the fact that the percentage of such complaints to the number of consumers is much greater in larger places than in small ones. Perhaps one reason for this is that the superintendents of the gas works in the latter are those who take the meter statements; for it is a well-known fact that, in nine cases out of ten, the superintendent of the gas company is the most popular man in the small community, no matter with what degree of aversion the company which he serves is held by the very same community. Nor can it be denied that the superintendent's word often settles a dispute that would remain an open one for many a day did its closing depend solely on the salve that would result from an explanation emanating from some one higher up the scale in the executive management.

New York Partially in Darkness.—The youthful Mayor of New York, spurred on perhaps by a desire to put Tammany Hall—and himself—in prominence at about the time that our annual fall elections are to be held, seems to be acting indiscreetly, to say the least, in the matter of the public lighting. The horrible death last week of lineman Feeks is, of course, to be regretted, and the cause that occasioned it ought to be relegated to the limbo of impossibilities, but we fail to see how either Feeks is to be avenged or New York to be benefited by the promulgation of an order that at once puts the metropolis in darkness—partially at least. During the long summer days twaddle and talk were the rule, but at that time the steps now so arbitrarily taken could have been made with equal force and with less inconvenience to the public at large. It goes without saying that the day of the overhead wire in New York is done, as is also the hour for the imperfectly insulated electric lighting conductor; but the time for the consummation of these desirable and inevitable things will not be hastened by any fine show acts of frenzied (?) politicians. New York in darkness may be a welcome spectacle to the adherents of Tammany—to some of them, at least—but illuminated New York is likely to be more pleasing to the great majority. In the meantime we might remark that in the days when gas lighting was solely depended on for our public illuminator the New Yorker could count on always being lighted home; and we might make the further remark that, under a well-planned scheme of gas illumination, in which improved street lanterns and burners would be given a fair opportunity, New York could always count on an effective and economical lighting service.

The Wheeling (West Va.) Election.—The reformers whose energies are directed to proving that municipal authorities should have control of the plants that supply gas and electric lights to the various communities, often refer to the success that has attended the management of the Wheeling municipal gas works. They, however, never refer to the disgraceful contentions that occur in Wheeling each fall when the Council is called upon to elect a Board of Gas Trustees; nor do they mention the fact that a change in the personnel of the Trusteeship often means a complete overturning and removal of the rank and file of the gas works employees. Under these conditions is it to be wondered at that occasionally—if not continually—the employees neglect *some* of their duties at the gas works in order that votes to continue them in their positions may be secured? These comments were brought out by our having read the following in a recent issue of the Wheeling *Intelligencer:* "The next regular meeting of Council is the time for the election of a new Board of Gas Trustees, and that new Board will be expected to make, without any marked delay, a general change in the force of men employed, both at the office and at the works, in order that some of those who hunger for the rich flavor that is supposed to attach to a political fleshpot may be satisfied."

At a meeting of the Wheeling (West Va.) Council, held on the 9th inst., a spirited contest over the choice of three gas works Trustees was recorded. The balloting resulted in the election of Messrs. W. H. Shafer, Harrison Dunlevy, and Gustavus Shultze.

Last spring a pier was constructed at Ocean Grove, N. J., which was pierced with eight gates, each of which swung upon a steel rod, so that the lower part of each gate would be submerged about 7 feet at high tide and about 2 feet at ebb tide. To the top of each gate—each of which is 13 feet in length—is attached a rod serving as an angle bar for the piston rod of a force pump, the force of each wave sufficing to effect a stroke of the piston, which operates to elevate water from the ocean into tanks 49 feet in height. It is said that one day in August, when the surf was by no means heavy, 40,000 gallons of water were raised to the tanks. The water is used for street sprinkling purposes.

(Continued from p. 509.)

Instruments for Measuring Radiant Heat.

By C. V. Boys, F.R.S.

It was with apparatus such as this, devised in the first instance by Mitchell, an English clergyman, that Coulomb made his famous researches upon the forces between electrified or magnetized bodies, and that Cavendish determined the mass of the earth.

The torsion of such a wire is so small that it might seem at first as if nothing finer could be required; but as a matter of fact, if the needles of an ordinary reflecting galvanometer were suspended by such wire, they would be held so immovably as to make them incapable of responding to such currents as are now easily measured. The forces and moments about which I have been speaking, though they seem very small indeed, are in reality enormous compared with those which can be easily measured. If still finer torsion threads are required a difficulty is met with. When wire is made much less than one five-hundredth of an inch it begins to suffer in the process of drawing. Copper wire is now made almost one-thousandth of an inch in diameter, but this wire is very weak and difficult to use. I have a specimen of silver wire of this size, given me by Mr. Lecky, which shows well the way in which the surface has been damaged in the process of drawing. As there is a difficulty in showing these fine wires and threads to a number by means of the projection microscope, I have asked Mr. Chapman to photograph for me, with a microscope, the series of wires and threads of which I have to speak to-night, all on the same scale. Photographs perfectly show the appearance that these things present under the microscope, and at the same time they serve most excellently to show the actual size of the several fibers. In the first place, there is a photograph of micrometer (Fig. 2). Each division is one-thousandth of an inch. I have made corresponding marks on the screen which will serve as reference marks when other slides are projected upon it. By way of giving some idea of the dimensions, I would point out that this wire to which I have so often referred would, on the scale on which the photographs are taken, completely cover the screen; it would appear about 25 feet wide. The next slide (Fig. 3) is an ordinary human hair, which I show because people speak of a hair as though it were very fine. The next slide (Fig. 4) is a piece of copper wire, about one-thousandth of an inch in diameter.

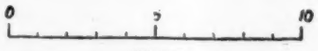


Fig. 2.

Fig. 3.

Fig. 4.

Very fine wire is made by Wollaston's process of enveloping a platinum wire in silver, and then drawing the compound rod into fine wire, after which the silver is dissolved by nitric acid. There is then left an exceedingly fine wire of platinum, which, however, is, I believe, useless as a torsion fiber. The photograph on the screen (Fig. 5) is taken from a specimen from which the silver had been dissolved only up to a certain place. The end of the silver and platinum core is evident. This is a two-thousandth of an inch in diameter; it is about the same size as a split cocoon fiber.

There is a beautiful material to which I imagine many experimentalists must have turned in their endeavor to find a fine torsion thread. I mean this soft, silky-looking material—spun glass. The photograph (Fig. 6) shows it to be fairly regular, and to be one-thousandth of an inch in diameter. This spun glass is a remarkable material in many ways. Experiments made in the physical laboratory at South Kensington, by Messrs. Gibson and Gregory, show that it is stronger than it ought to be if its diameter only is taken into account. Their results are expressed in dynes per square centimeter, but for purposes of illustration, and because we are familiar with the strength of metals expressed in tons to the square inch, I have put their results in this form. Glass fibers about one-thousandth of an inch in diameter have a strength of about 27 tons to the inch. The same glass in rods from 20 to 50 times as thick is from one-third to one-seventh the strength.

Thus it appears that though glass itself will not compare with iron in strength, spun glass has about the same strength as iron. On the other hand, while fine metallic wires are also stronger than they should be, I believe that when they are made as fine as possible the strength does not go on rising, but ultimately falls away again. Thus it is that spun glass is—or rather was until lately—the strongest thing of its size obtainable. This property of great strength is very valuable, because it makes it possible to suspend larger apparatus, and therefore to obtain larger effects than would be possible with a weaker material, or what comes to much the same thing, a finer fiber will carry a certain apparatus, and therefore there will be a greatly diminished torsion and increased sensibility. Other points in favor of spun glass are its uniformity, its freedom from atmospheric influence, and the fact that pieces of almost any length may be obtained.

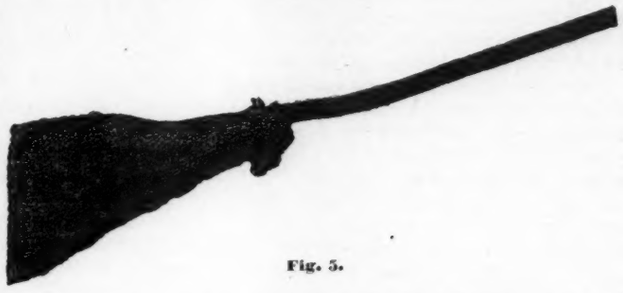


Fig. 5.

There is, however, one very serious defect, which is so pronounced as to make this otherwise splendid material absolutely useless in instruments of precision. Suppose that the thing suspended carries a mirror, by means of which the deflection can be accurately observed. Now, it is found that when all has come to rest, if a large deflection is produced by any means, then the zero is changed; the index comes to rest in a new place, and this place is not constant, but slowly approaches the old position of rest. In some experiments which I made two years ago I found this change of zero to be about 1-430th of the deflection if the mirror was kept deflected for one minute. Now, the fact that the zero is changed every time the fiber is twisted, and that after deflection it is itself variable in position, make spun glass a useless material for exact work. I may, however, say that I have found that this defect may be partially cured, if the angles of deflection are not large, by annealing the glass in a box of charcoal at a low red heat. In the case of a fiber 9 inches long, and turned one complete turn, I found the change of zero after annealing to be about one-sixth of what it was before annealing.

It is partly for this reason, and partly because the torsion of spun glass is still so great, though it is only about one-third of what a brass wire of the same size would have been, if such fine wire were obtainable, that spun glass is never used in the construction of instruments.

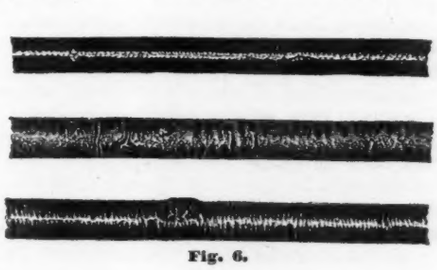


Fig. 6.

There was until lately no means of producing torsion threads finer than spun glass, and therefore the method of using torsion has been abandoned in all the more delicate apparatus, and fibers without torsion have been looked for which might be used to suspend the movable part of the instrument, while some subsidiary means is made use of to direct and give stability to its movement.

The most perfect torsionless fiber that I know of is the spider line. In the paper by the Rev. A. Bennett, to which I referred last week, there is an account of his experiments with spider web. He found that if he magnetized a sewing needle, and suspended it by a piece of spider web

2 inches long, he could turn the upper end of the web round 800 times, and yet the needle was not deflected to a visible extent. By way of making a more delicate experiment, he heated a piece of fine harpsichord wire in a candle flame, and allowed it to cool in the magnetic meridian, so as to obtain a very weak magnet. This, hung at the end of a web 3 inches long, was not moved to a visible extent when the upper end was turned 1,000 times. Finally, he attached one fiber of the feather of a goose quill to a piece of web 2½ inches long, and then turned it by a spinning machine more than 1,100 times, but the fiber did not go round. The thread became one inch shorter.

I do not think that much use has been made of spider line, except for cross wires in telescopes, and this is remarkable, for the very elaborate investigations of Joule show it to be a trustworthy material. Joule experimented on the threads of the diadema spider, which are especially strong. Bennett does not specify the kind of spider that he went to for his threads. The strength of the diadema threads must be very great; Joule found that they were able to carry from 24 to 27 grains before breaking, and that they would carry for an indefinite time a load of 10 grains. He also found that with change of temperature the length of the loaded thread changed also, becoming shorter when warmed, and longer when cooled. It also increased in length in a moist air, and contracted again in a dry air. However, the amount of this change is not very great. In a dry air a thread 23 inches long, and carrying 10 grains, would not change in length more than one-sixth of an inch, on an average, for a change of temperature of 100° F. In six months it did not increase by one-thousandth of its length. When the dry air was changed for wet air the filament at once became half an inch longer. The length of diadema web does not seem to be subject to more uncertainty than the length of silk under the same conditions. If this diadema thread is as free from torsion as the spider thread used by Mr. Bennett, it would seem to be a perfect material for use in exact instruments. Why it is never* used I am unable to say. Joule speaks as though he used it in his arrangement of dip-circle, in which the needle is slung upon two loops of filament; but he says in the description of this instrument that he used silk.

Silk, as produced by the silkworm, consists of a pair of threads gummed together, about two-thousandth of an inch in diameter apiece (Fig. 7). The silk must be washed in hot water to remove the gum, and

Fig. 7.

the two fibers separated. The single fiber, according to A. Gray†, will carry a weight of about 3 to 4 grammes before it breaks, and will safely carry needles weighing from half to 1 gramme. The strength is approximately 340×10^7 dynes to the square cm., or 22 tons to the square inch. Though finer than spun glass, it is not quite so strong; it has a strength approaching that of ordinary iron. Silk has until lately been the material always used in instruments of the highest degree of precision. It has many valuable properties, but it is worse than glass in some respects. The torsion is so small that it is quite a usual thing to ignore it, though of course this should not be done in accurate experiments. Gray has given the results of his measures on the torsion of silk. Owing to the irregularity in the diameter, and the fact that it is not round, the figures are subject to a good deal of variation; however, they are worth giving, as they will be useful for purposes of comparison.

He finds that fibers from .0009 to .0015 centimeter in diameter have a moment of torsion of from .00091 to .0025 dyne-centimeter units. These measures give as the coefficient of torsion of the silk material numbers ranging from 1.39×10^9 to $.495 \times 10^9$; or a rigidity of $.885 \times 10^9$ to $.316 \times 10^9$ when expressed in C.G.S. units. The rigidity of spun glass, found by Messrs. Gibson and Gregory as the mean of a large number of experiments, is 205×10^9; so that it would appear that glass is from 230 to 650 times as rigid a material as the substance of which silk is made. Joule found that silk behaves much in the same way as spider thread when subject to heat and moisture.

The figures I have given are sufficient to show that the torsion of silk must be very small. Since it has a diameter about half that of spun glass, the torsion on this account would be $\frac{1}{16}$; and since the rigidity is so much less as well, the actual torsion is from 4,000 to 10,000 times less. We have already seen that the torsion of spun glass itself is so small that very feeble forces can be measured with it, but the torsion of silk is many thousand times less. No wonder that, since it is also as strong as bar iron, silk is nearly universally used.

It is, or rather was, universally used, because there was nothing better; good as its properties are, minute as its torsion is, I do not know any one who is altogether satisfied with it. The figure which represents its rigidity is true enough, and yet it is hopelessly delusive. Though the torsion, actually, is small, it is not constant; every variation of temperature or moisture sets some new power in action so that the position of rest is never the same. This cannot be corrected by increasing the length of the fiber, because the uncertainty of the position of rest may be increased in the same proportion. Finally, there is the same kind of elastic fatigue that I have described as making spun glass useless, and in a far higher degree, but the actual disturbing force here is so small that it is sometimes overlooked, though it absolutely prevents any galvanometer from approaching the accuracy that would be obtainable with a perfect fiber.

Mr. Bosanquet, in a short article* which attracted a good deal of attention at the time, says:

"At certain times the needle of the galvanometer would move about with sudden and capricious movements, the mirror often traversing several degrees of the scale. The decision and sharpness of the movements were very remarkable, and we habitually spoke of their cause as the 'ghost.' The ghost used to visit us mostly in summer, between the hours of 9 and 11 in the forenoon, and 6 in the evening; when these movements began it was no use attempting to work with the galvanometer. There can be no doubt that the movements were due to the solar heat falling more or less directly on the instrument, and causing hygroscopic changes in the silk fiber."

He concludes the article as follows:

"It is my conviction that silk and thread suspensions are sources of error and inconvenience to an extent that has been imperfectly realized, and that they ought to be entirely banished from all instruments of precision."

Mr. T. Gray,† who advocated the use of silk, while admitting that silk is not perfect, employed language which is hardly as strong as the subject deserves. He said:

"When a galvanometer is made sufficiently sensitive for the fiber to play an important part in directing the needle, the set of the fiber, due to continued deflection, always produces an apparent change of zero which, in exact measurements, it is somewhat difficult to properly allow for."

Mr. Gray went on to say that the error is small, except in very special cases, and is in no way capricious. I believe I express the general feeling among experimentalists when I say that the behavior of silk under ordinary circumstances appears, whether it really is so or not, extremely capricious.

Now, having insisted on the defects of the nearly universally employed material, silk, I will next propose the remedy which I described before the Physical Society,‡ and which my later experience, confirmed by that of others, shows to be a remedy which is complete.

In my experiments on the development of the radio-micrometer, of which I shall speak this day fortnight, I required a torsion fiber finer than spun glass and free from the vagaries of silk. I required a thread with a torsion no greater than that of silk, of great strength, and more perfect if possible than glass or any of the metals in its elasticity. Such a thread, if found, would be valuable not only for my experiments, but for almost all investigations, the accuracy of which is limited by the defects of our present apparatus.

My first endeavors were to make glass fibers finer than spun glass, and I concluded from my experiments that the conditions for success were a very small quanty of melted glass, a very high temperature, and the instantaneous production of a very high velocity. These conclusions I tested by the very simple process of attaching a fine rod of glass to the tail of an arrow, and then, when a bead had been melted with the oxy-hydrogen jet as large about as a pin's head, shooting the arrow over the longest range that I could conveniently make use of. Under these conditions the bead of glass remains suspended in mid-air under its own inertia, while the arrow goes on its journey; but when the arrow has struck the target, there is found floating in the air, far too fine to fall quickly, a delicate thread of glass, no thicker sometimes than a single spider line. If, instead of glass, a fine rod of melted quartz is fastened to the arrow, held at the free end with the fingers, and heated to the highest temperature attainable with the oxy-hydrogen jet, then a thread of quartz can be produced in the same way, and, as you see, the process is perfectly simple and easy. [A quartz fibre was then shot, and its existence made evident by fastening to it a gummed label.]

(To be continued.)

*Mr. Bottomley has told me since these lectures were delivered that he has found the spider line invaluable for suspending the mirror of a very delicate galvanometer.

† "Absolute Measurements in Electricity and Magnetism."

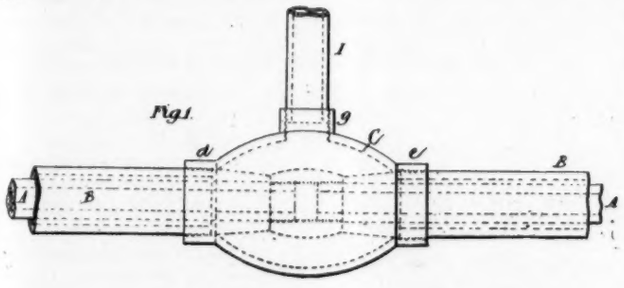
* "Phil. Mag.," Dec., 1886. † Jan., 1887. ‡ June, 1887.

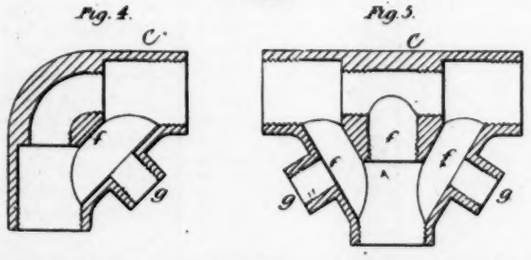
The Hattery Coupling for Gas or Other Pipes.

The Hattery coupling device (protected by U. S. Letters Patent No. 412,255) is about ready to be placed on the market. In his preliminary specification the inventor claims that his purpose was to devise a means for preventing "explosions of gas"—either natural or manufactured—and to control the use of such vapor with perfect safety in either house or factory supply.

His invention consists mainly in a special construction of fittings—that is of couplings, elbows, T's, crosses, or other pipe connections—not only made very heavy and strong, but also adapted for two lines of pipe placed one within the other, and made integrally with a chamber or passage, whereby any leakage of gas from the inner and heavier pipe leading up from the well may be carried off and led either to a point where it may be used, or to any high point where it may harmlessly escape—as, for instance, above the top of a building.

Fig. 1 shows in elevation one of his improved couplings with sections of pipe jointed thereto; Fig. 2, a central longitudinal vertical section of the coupling shown in Fig. 1; Fig. 3, a central cross vertical section of the same. Figs. 4 and 5 show central longitudinal vertical sections of two other styles of couplings; Fig. 6, a cross section of the double pipe.





He makes the inner or main pipe *A*, which is to convey the gas from the well, very heavy and strong, so that it may be able to withstand the greatest known pressure of the gas which it conveys without bursting. This entire line of pipe is then inclosed within another one *B*, larger but not necessarily so strong, leaving between the exterior of *A* and the interior of *B* ample space to receive and carry off any gas that may escape or leak from the joints or defects in *A*. The pipe *A* receives the full pressure of the gas well—and here he remarks that he is aware that the mere inclosing of one line of pipe within another line has been practiced before, but not, so far as he is aware, with the inner pipe relatively much thicker and stronger than its surrounding one, and also with couplings or fittings such as he describes, and which constitute the leading or most essential parts of his invention.

The improved fittings *C* are adapted for coupling or connecting together the ends of both the inner and the outer pipes *A* and *B*, and such fittings not only have both of their threaded and pipe-jointed portions *d e* made integral with the body of the fitting *C*, so as to be permanently fixed therein without the need of screws, pins, or other fastenings, but each fitting is also provided with a chamber *f*, serving to receive or collect any gas that may leak from the inner pipe into the outer one to prevent its escaping, and to insure its safe conduct to any desired place for use or otherwise. Thus each fitting, whatever may be the well-known or needed shape of the fitting—that is, whether they are mere couplings, or are elbows, H's, L's, T's, crosses, or of any other exterior form that exigencies may require—are each and all under the invention made not only adapted to receive the larger and smaller pipe sections—one within the other—and also strong and thick enough to prevent bursting from the greatest interior pressure, but each has also its own chamber or passage *f*, made within and forming part of it, and the added part of the metal in which such bye-pass is made also adds proportionately to the already great strength of the fitting, while this strength is also further enhanced by the interior jointing portion *d*, which makes the fitting at that part so much thicker, and re-enforces it transversely at its central part and for a considerable portion of its length.

It will be understood that the chamber or passage *f* is not merely the annular continuation of the space between two concentric pipes, but that it is a special passage made in the fitting and leading from such space.

For the safe escape of any gas which might leak from any of the screwed joints of the interior pipe *A*, each fitting is preferably made with an outlet *g*, to be connected with any suitable outer pipe *I*, which may terminate, as desired, with an open upper end above the roof of a house, to let off the escaped gas harmlessly into the atmosphere, or this pipe may be used to lead the escaped gas, which, of course, has a relatively low pressure, to any point where it may be used for heating or illuminating.

Either the outer or the inner pipe may be tapped in order to take gas for illuminating or for heating.

Piles and Pile Driving.

Mr. Charles Davis Jameson, C.E., is contributing an excellent series of papers to the *Railroad and Engineering Journal*, on the subject of the "Use of Wood in Railroad Structures." On account of their general interest to gas men, who are often called upon to practically deal with the matter of wooden piling, we herewith reproduce Mr. Jameson's chapters on "Piles and Pile Driving," and "Rams and Hammers:"

Among the first points to be considered in driving piles is the thickness and character of the different strata through which they have to be driven; also the depth below the surface at which strata of sufficient firmness to support them can be reached. These are the principal points that have to be taken into account where piles are driven for the purpose of supporting any superincumbent weight.

There are two methods of forcing piles into the ground. One, which has been used thousands of years, and until very recently was the only method, is that of forcing them into the ground by means of blows or impact of some kind. The second method, which is of comparatively modern date, and can only be applied economically under particular circumstances, is that of *screwing* them into the ground, the point of the pile being furnished with a large metal screw point, and a rotary motion given to it by means of levers or other suitable mechanism.

The object of the use of piles is to replace loose, unstable ground with something that is firm, solid, and capable of bearing with safety all the weight that of necessity comes upon it. Piles are used either to support a superincumbent weight, as when they are driven to form the foundations of buildings, piers, retaining walls, etc.; or they are used in the form of sheet piling, to support banks of earth or loose material, something in the form of a retaining wall. They are frequently used as sheet piling to support the sides of excavations for foundations of buildings, piers, or abutments, or in excavating deep trenches through material which is not sufficiently firm to hold itself vertical during the time of excavation. For the first object—that is, serving as the foundation for a building or piece of masonry—it is very necessary that the piles should penetrate to solid ground or rock, if possible. Very often there is not enough attention paid to this fact. One reason for this lack of attention is, that as the pile is driven lower and lower, at last a point is reached where it sinks very little after each blow of the hammer, and it is very apt to be considered that when the pile has reached this point it has sufficient solidity to bear the required weight. But one great cause of the slight penetration of the pile after it has been driven to a certain extent is the increased amount of friction between its sides and the material through which it passes. The amount of this friction depends to a certain extent upon the class of material. In the case of sand, it is almost as impossible to drive a pile any distance through it as it is through

solid rock, and in gravel the difficulty increases the finer it gets. That is, starting with sand, the difficulty experienced in driving piles is almost inversely as the size of the particles of which the material is composed.

Another thing to be remembered in driving piles to a secure foundation is the difference between the ultimate load that is to rest on them and the quick blow of impact which is given them in driving. It is an established fact in mechanics, and also in practice, that a permanent load resting upon a pile will eventually have nearly ten times as much effect upon it as that same load brought quickly upon it and as quickly removed. So that although the pile may penetrate a very little distance from each blow of the hammer, and the weight of the hammer multiplied by the velocity which it has at the time of impact may give a blow that in pounds is much greater than any weight that will come on it from its permanent load, still, after the permanent load has been resting some time upon the pile we very often see examples where it begins to yield, the foundation sinks, and as in very few cases it sinks with regularity over its whole surface, the result is that, if the superincumbent load consists of masonry, one part sinks while the other does not, and there is a crack or fracture in the masonry. There have been cases where none of the piles in a foundation were driven sufficiently far, so that when the masonry was built upon them the whole foundation sank with perfect uniformity. This, in itself, was not of much consequence, particularly if the structure resting upon the masonry was not an arch. In case it was a masonry arch it became broken. Wherever there is any doubt about the foundation, and where there is any probability that it will yield to the weight of the piers upon it, it is always better to span the opening by means of a girder rather than a masonry arch, for the reason that the sinking of one end of a girder, up to a certain amount, is of comparatively little consequence. In case the opening is spanned by a metal arch, among many other advantages of using what is called a hinged joint is the one that, if the foundation yields slightly, it does not in any way affect the arch, as owing to the hinge the arch can accommodate itself to the new circumstances.

Where piling is to be done to any great extent, and there is great doubt as to the distance the piles will have to be driven in order to encounter a firm foundation, the material should be tested, either by boring until solid material is encountered, or by driving what are called test piles. But even where the greatest care has been used there have been numerous examples where the character of the ground changed so much within a comparatively short distance that these borings and test-piles were of absolutely no use in the subsequent work.

In regard to the timber for piles, hemlock, pine and spruce constitute the principal timber that is used in this country. Of course, the piles should be as straight as possible, and where they are to be used under water should be stripped of their bark and used in the green state. The great danger from driving piles is the splitting of the pile, and the necessity of extracting it or sawing it off and driving another one near it. Anyone who has had any experience in pile driving will appreciate at once the great difficulty of pulling piles. It is almost impossible in ordinary work, but where the work is carried on in tide water, a very convenient way is to lash the pile very tightly to two timbers, at low water, that rest upon scows, and when the tide rises the force of the water itself will very often raise the pile.

Where piles are used entirely under water, so that they are kept wet all the time, they will last almost any length of time, provided they are not subject to the attacks of the *teredo navalis*, or pile worm. This pest is only encountered in salt water, and in greater quantities the nearer we approach the equator. It works between high and low water, and in a very short time cuts the piles off. A great many different remedies have been tried to withstand the attacks of this worm. The creosoting process is probably the most successful of any of the chemical treatments to which wood has been subjected for this purpose. A very good method, although expensive, is to sheathe the piles entirely with copper, which, of course, withstands the sea water and the attack of the *teredo*. This trouble of using wooden piles in salt water has led to the very extensive use of iron piles. This subject of iron piles will be taken up later.

Where the timber is too large to be used in one piece, and where the best of timber is necessary, only the heart should be used.

The piles that we have just described—that is, those for the support of a superimposed load—are what are called bearing piles, while sheet-piles, as we have said, are for the holding up of banks of earth, during excavation or permanently. Piles are also driven in some cases in order to consolidate ground which otherwise is too loose and unstable to bear a weight. In this case the piles are usually short, and driven very closely together, beginning with the outside circle and driving toward the center. This method, however, has gone very much into disuse of late years, owing to the fact that most engineers prefer to use concrete in such ground rather than to consolidate it by means of piles.

Fender piles are simply what their name would indicate—that is, piles driven in front of large masonry walls or other important works, in order to protect them from sudden blows.

At different times piles with screw points have been tried, the screw points having been made of cast iron and about 2 feet in length. They never have been particularly successful, are very expensive, and should never be used except where the material through which the pile is driven consists of sand, or where timber is so expensive that there is an actual gain by the use of cast iron points.

Rams and Hammers.—The ordinary method of driving piles is by dropping a weight, either a ram, a hammer, or a monkey upon them. This weight in some cases is made of timber loaded with iron, but usually of cast iron. It is raised either by means of hand power or steam, usually by steam. The exact effect of these blows upon the top of the pile is not known. The effect from experiment is verry irregular. The actual force with which the hammer strikes the pile can be easily calculated from the formula for accelerated velocity and the law of falling bodies. The body will fall through a space S, in the time $\sqrt{\frac{S}{g}}$ where g equals $16\frac{1}{2}$ ft., or the space that a body falls in one second. The acquired velocity is directly proportional to the time of the fall, and the velocity at the end of the first second is $32\frac{1}{2}$ ft. Hence, falling through any space the velocity that will be acquired by a body will be $32\frac{1}{2}\sqrt{\frac{S}{g}}$ From this we have the velocity that the ram or hammer will have after having fallen any required distance. Then, to find the force with which that hammer will act upon the head of the pile, we have simply to multiply the weight of the hammer by this acquired velocity, and we have the number of pounds with which the hammer acts upon the head of the pile. We must remember that the velocity to be used in this case is not the velocity that the hammer had in the second before it reached the pile, but the velocity that it would have had in the next second if it had not been stopped by the pile.

From the above equation the accompanying table No. 1 has been calculated, showing exactly the force of impact of a hammer weighing one ton falling through different distances.

TABLE I.

Fall of Ram in Feet.	Time of Descent in Seconds.	Force in Tons for a Ram Weighing One Ton.	Fall of Ram in Feet	Time of Descent in Seconds.	Force in Tons for a Ram Weighing One Ton.	Fall of Ram in Feet	Time of Descent in Seconds.	Force in Tons for a Ram Weighing One Ton.
1	0.25	8.0	15	0.96	31.0	28	1.32	42.4
2	0.35	11.3	16	1.00	32.1	29	1.34	43.2
3	0.43	13.9	17	1.03	33.1	30	1.37	43.9
4	0.50	16.0	18	1.05	34.0	31	1.39	44.6
5	0.56	17.6	19	1.09	35.0	32	1.41	45.4
6	0.61	19.6	20	1.11	35.9	33	1.43	46.1
7	0.66	21.2	21	1.14	36.7	34	1.45	46.8
8	0.70	22.7	22	1.17	37.6	35	1.48	47.4
9	0.75	24.1	23	1.20	38.5	36	1.50	48.1
10	0.79	25.3	24	1.22	39.3	37	1.52	48.8
11	0.83	26.6	25	1.25	40.1	38	1.54	49.4
12	0.86	27.8	26	1.27	40.9	39	1.56	50.1
13	0.90	28.9	27	1.29	41.7	40	1.58	50.7
14	0.93	30.0						

In regard to the weight of the ram that should be used, opinions differ among engineers. A heavy ram or hammer with a very short blow is undoubtedly the best for many reasons; the only drawback to it is the increased amount of power necessary for raising the hammer. A light hammer with a long fall is very apt to split the pile, and by an examination of this table it can readily be seen that the effect of a blow does not in any way increase directly as the fall increases. Thus, a hammer falling 6 ft. gives a force of 20 tons, while a hammer falling 12 ft. only gives a force of impact of 28 tons. Thus, while we have doubled the distance through which we must move the hammer, we have only increased the working force from 20 to 28 tons.

The height of fall is also a question upon which there is great variation of opinion, but there is one thing that we must remember—that these rams or hammers in falling are not allowed to fall freely—that is, they are held in the leads of the pile driver, and, of course, there is a certain amount of friction between the sides of the hammer and these leads; this friction is so great that there is absolutely nothing gained by making the leads over 40 feet.

The weight of the hammer should be proportional to the cross section

of the pile that is to be driven. Take a pile 10 or 14 in. in diameter, and the hammer should be from 1,000 to 1,700 lbs. in weight. The following equation will give approximately the weight of hammer for the most economical driving of the pile under the following circumstances:

F = fall in feet.
W = weight of the ram.
B = breadth of the pile in inches.
T = thickness of the pile in inches.
L = length of the pile in feet.
W_1 = weight of the pile in pounds.

We then have the following equation:

$$W = W_1 \left(\frac{F \times W_1}{5\ B\ T\ L} - 1 \right).$$

When the pile is square, the term $B\ T$ can be replaced by S^2.

The weight of the hammer and the distance through which it falls are not the only points to be considered in connection with the driving of piles. The rapidity with which the blows can be given is a very important point and must be considered. For instance, in material like sand or silt, at every blow of the hammer the pile is driven a certain distance, the material through which it is driven is disturbed to a certain extent, and if the blows are repeated with sufficient rapidity not to allow time between the blows for the material to settle back into place, there is comparatively very little friction between the sides of the pile and the material. The pile can be driven to a very great depth with little injury to itself, and the material settles back, afterward rendering it very firm; but if the interval between the blows is of such length that the material has time to settle back into place after each blow that has been given, then, especially in sand mixed with water, it becomes almost as impossible to force the pile down as if it had been driven through solid rock. From this can be seen the great advantage of rapidity in the blows. This is what forms one of the greatest advantages in the use of the different steam hammers, or steam pile drivers, so-called, that have recently come into such general use. A description of these pile drivers will be taken up later.

In salt water, or where timber would be subjected to an attack of the *teredo*, cast iron piles have been used with great success. There were strong objections made to their use in the first place, owing to the fact that it was supposed that they would be corroded in a short time and thus rendered useless. Of course, years enough have not yet gone by to prove by the test of time that cast iron piles will stand the corroding action of salt water, but according to the experiments that have been made, there is every probability to suppose that cast iron piles will under ordinary circumstances last hundreds of years. It has been found that if they can be driven in such a way that the outside skin or casing of the casting is not broken, the action of the water is very much less than if this skin is fractured and the water allowed to get upon the interior part.

In regard to the supporting power of piles, this is a question which, if certain premises are allowed, can be thoroughly treated from a theoretical standpoint, and most accurate mathematical results arrived at. The only trouble is that no two piles have the same surrounding circumstances, or can be treated in exactly the same way, so that all the formulas that are given for the supporting power of the piles have to be used with caution, and in very many cases their results will not be borne out by actual experiment.

In regard to the following formulas, they must all be used with caution, owing to the fact that there is great variation in the material through which the pile is driven. The following formula is by Weisbach:

$$L = W \left(\frac{W}{W + W_1} \right) \times \frac{H}{D}$$

In it W is the weight of the ram in tons, W_1 the weight of the pile in tons, H the height of the fall of the ram in feet, D the depth which the last stroke drives the pile.

The following formula is taken from Rankine, and shows the relation between the blow required to drive the pile to a given depth, and the greatest load that it will bear without sinking further, supposing it to be supported by a uniformly distributed friction against its sides. Let W be the weight of the ram, H the height from which it falls, D the depth through which the pile is driven by the last blow, P the greatest load it will bear without sinking further, S the sectional area of the pile, L its length, E its modulus of elasticity; then the energy of the blow is thus employed:

$$W \times H \frac{P^2 \times L}{4\ P\ S}$$

This is the portion employed in compressing the pile, and $P \times D$ multiplied in driving it.

From which P equals

$$\sqrt{\left(\frac{4\ E\ S\ W\ H}{L} + \frac{4\ E^2\ S^2\ D^2}{L^2} \right)} - \frac{2\ E\ S\ D}{L}$$

The piles are generally driven until P by this formula equals 2,000 or 3,000 lbs. to the square inch of sectional area, and as their working load is from 200 to 300 lbs., that gives a factor of safety of about 10.

It is very important that all the piles which are to bear a distributed load should be driven uniformly, so as to insure that each pile is supporting its proper share of this load, and it is necessary to have some data to adhere to in driving them.

The following very simple formula by Sanders probably gives as good results as any, where

$$W = \frac{R}{8} - \frac{F}{D}$$

where W is the weight that can be safely placed on the pile, R the weight of the ram. F the fall of the ram in making the last blow, and D the distance the pile sinks with the blow.

Comparing these formulas, we find that Rankine and Weisbach give the supporting power of the pile about 5½ times as much as Sanders, but as each of these authorities state that the safe working load should be from $\frac{1}{5}$ to $\frac{1}{4}$ of the amount given by their formulas, the result will come very near to that given by Sanders.

The accompanying table, No. II., gives the supporting power of piles, calculated by the aid of the various formulas:

TABLE II.

No. of Pile.	Depth in Ground.	Total Length of Pile (L).	Value of $P = L \times 0.22$.	Value of D.	Value of F.	Sanders's.	Rankine's.	Weisbach's.
	Feet.	Feet.	Tons.	Feet.	Feet.	Value.	(W) in	Tons.
1	15.00	20.00	0.440	0.0573	10.58	23.09	111.68	128.22
2	13.00	18.00	0.396	0.1094	11.83	13.52	87.03	77.75
3	12.00	17.00	0.374	0.0833	10.00	15.00	91.41	87.72
4	12.50	17.50	0.385	0.0833	10.50	15.75	94.52	91.34
5	13.25	24.75	0.544	0.0313	10.00	40.00	122.04	206.93
6	13.00	24.75	0.544	0.0677	11.50	21.23	103.79	109.53
7	13.67	25.17	0.544	0 0885	10.00	14.12	81.37	72.71
8	16.00	27.50	0.605	0.0573	10.00	21.82	97.69	109.31
9	15.58	26.33	0.579	0.0625	10.00	20.00	95.52	101.33
10	16.00	27.00	0.594	0.0625	10.00	20.00	94.82	100.38
11	16.75	27.50	0.605	0.0625	10.00	20.00	94.33	99.69
12	17.50	28.25	0.622	0.0469	10.00	26.67	103.97	131.45
13	14.67	24.17	0.532	0.0729	10.00	17.14	91.05	89.42
14	13.50	23.50	0.517	0.0833	10.00	15.00	85.47	79.14
15	17.67	26.17	0.576	0.0678	10.00	18.46	92.31	93.71
16	17.25	25.75	0.567	0.0573	8.00	17.45	85.06	89.11
17	18.25	23.73	0.522	0 0781	10.00	16.00	88.28	84.09
18	18.67	24.17	0.532	0.0833	10.00	15.00	84.93	78.33
19	14.92	20.42	0.449	0.0833	10.00	15.00	88.16	82.82
20	16.25	21.75	0.479	0.0729	10.00	17.14	93.45	92.72

The letters have the following signification:

W = the safe load on the pile in Sanders's formula and the theoretical load in Rankine's and Weisbach's.
F = the fall of the ram in making the last blow.
D = the distance the pile sinks with the last blow.
R = the weight of the ram, which is taken constant and equal to one ton.
L = the total length of the pile.
P = the weight of the pile.
S = the sectional area of the pile, which is taken at 0.7 of a foot.
E = the modulus of elasticity, with a value of 331,100 inch pounds.

Where piles are to be driven any distance, and through material that presents any particular resistance, the head of the piles should always be banded by means of a heavy wrought iron ring, this ring being made of about ¾-in. iron 3 in. broad. If, during the process of driving, the head becomes bruised so as to form a sort of a cushion, this bruised portion of the pile should be instantly sawed away and the head rebanded, since as much as four-fifths of the effective force of the ram soon becomes absorbed in this semi-elastic cushion.

In regard to shoeing piles, unless the material presents a great deal of resistance, it is not absolutely necessary to shoe them. They should be pointed to a certain extent, and, when necessary, shod by means of wrought iron or cast iron shoes. The simpler the form of the shoe, of course, the less expensive the work. Any treatise on pile driving shows the different forms of shoeing that are used.

In driving piles in deep water, or under circumstances where it is nec-

essary for the pile driver to be placed a great distance above where the ultimate top of the pile is to come, in order to save timber the piles are only cut the required length, and when the top comes below the bottom of the leads, a dolly or follower is used to drive them farther. This is simply a piece of timber approximately the same size as the pile, and set upon the top of it. Under some circumstances an iron dowel is used, or a very broad band encircling both the top of the pile and the bottom of the follower. There are many objections to using a follower, and it should only be used when, from an economical standpoint or other circumstances, it is impossible to use timber of sufficient length to dispense with it. In using a follower, from half to three-fourths of the force of the blow is often absorbed in the follower itself, and is no way effective in driving the pile. This constitutes one of the greatest disadvantages connected with the follower. Another disadvantage is the great difficulty in driving the pile true, as far as its direction goes.

The Ammonia Industry in England.

Industries, which keeps a sharp lookout over matters connected with the gas industry, recently printed an article on the above-named subject. Having pointed out that this industry, like many others, owes its existence to the necessity for removing a nuisance, it goes on to say: The ammoniacal liquor of gas works—an apparently useless and an offensive product of gas manufacture—had to be got rid of somehow; and this necessity led to the recovery of one of its constituents as a distinct business. But once established as a profitable commercial undertaking, for the produce of which there was a ready and an expanding market, the processes of recovering, in the form of sulphate, the ammonia contained in this product of coal distillation, were soon extended to other sources than that above mentioned. In this way, as well as in the development of the manufacture by improved methods of procedure, the industry rapidly grew, till now it has attained considerable magnitude. Hitherto its progress had been unobserved outside the circle of those immediately interested; but from its present important position it claims, and is beginning to receive, public attention. After these introductory remarks our contemporary proceeds to give the following general facts and figures in regard to the ammonia industry.

Numerous and important as are the uses of the sulphate of ammonia, this substance is never made the object of direct manufacture. In all cases it is collected from the products of other manufactures formerly allowed to go to waste. Nor is it likely to be ever otherwise obtained; for we can hardly conceive of a cheaper source being discovered. Moreover, the present sources are inexhaustible; so that no necessity can arise to seek for others. Wherever coal is consumed in large quantities, there we have the raw material for the manufacture of the sulphate of ammonia. At the present time the bulk of this substance is derived from the liquor of gas works; and from that source we are likely to obtain our chief supply for some time to come. But besides this a large quantity is derived from the shale works, in which a bastard coal is subjected to distillation for the purpose of obtaining petroleum oils and paraffin. Other sources likely to grow in importance are the blast furnaces of the iron works and coke ovens. The gases from the former, instead of being allowed to burn in open flame are brought down for use as a heating agent; but often before being burned the ammonia is separated from them. Still another source, likely to become of great importance is the producer of heating gas—the apparatus for the conversion of fuel into the gaseous form. The fact that a marketable product may be obtained from the waste gases constitutes one more inducement to large consumers of coal to adopt this system of conversion. Messrs. Brunner, Mond & Co., of Winnington, in Cheshire, nearly cover the cost of the coal consumed on their works by the sale of the sulphate of ammonia recovered.

As there is no lack of the raw material to operate upon, so there is abundant room for further development in the processes of recovery. Great advances have been made in recent years, not in the discovery of new processes, but in the more skilful application of the old methods. Improvements in this direction have enabled works to more than double their production, while halving the expense for fuel. Hence the cost of production has been considerably diminished. Ten years ago the cost of making a ton of sulphate from gas liquor was about £15. Now the sulphate may be bought in the market for £12. The question how much sulphate can be obtained from a ton of coal is not easily answered. Much depends on the quality of the coal, and much also on the method of burning it. The latter condition admits of little or no improvement, inasmuch as the coal is never, as before stated, burned for the sake of the ammonia. In gas works 1 ton of cannel coal will yield about 8 gallons of liquor; and, on an average, this quantity of liquor will contain sufficient free ammonia to form 0.8 lb. of sulphate. But this quantity is far below the possible yield of a ton of even ordinary coal. From Mond's gas producers (already mentioned) the quantity of sulphate obtained amounts to 66 pounds per ton of slack consumed; and this is said to be only half of what might, under specially favorable conditions, be gained. The plant erected at Winnington is sufficient to deal with 200 to 240 tons per day of 24 hours, yielding from 6 to 7 tons of sulphate. Hence we see that the progress which is being made in this direction for economizing fuel—progress which is likely to be more rapid in the future than in the past—opens up a prospect of a greatly increased production of ammonia.

In the last decade the sulphate of ammonia industry has constantly and steadily developed itself, and considerable progress has been made in the last three years. A few statistics will show the vitality and present position of this young industry. The production, in 1886 in the United Kingdom amounted to 106,610 tons; in 1887 it rose to 113,896 tons, to reach in 1888 a total of 122,785 tons. On the Continent the growth of the industry has been no less remarkable. The statistics of production in Germany in the last three years show a rate of progress similar to that which has taken place in this country. If we analyze the production of which the foregoing figures represent the totals, the result is equally satisfactory; for we find the increase under all heads. Thus we have in the years 1886, 1887, and 1888, respectively, from the gas works, 82,480, 85,022, and 92,896 tons; from the shale works, 18,080, 21,098 and 22,072 tons; from the iron works, 3,950, 5,098 and 5,280 tons; and from the coke ovens, 2,100, 2,678 and 2,537 tons. It is not easy to account satisfactorily for the slight falling off in the place of an increase in the quantity obtained last year from the coke ovens relatively to 1887. Abroad, particularly in Germany, the production from this source has continued to increase, and greater attention is now being given to the blast furnaces as a source of supply. Taking the market price of £12 a ton, the value of the sulphate produced last year in the United Kingdom is £1,473,420. The figures quoted indicate the growth and the present importance of the industry. A considerable export trade in sulphate of ammonia has sprung up. This, however, is likely to shrink away as the industry is developed abroad. In the first seven months of the current year, Germany imported 15,924 tons, of which more than three-fourths was derived from Great Britain. This quantity is considerably below that of the corresponding period of last year. The greater part of the sulphate produced is sold as a manure, for which use it is gradually growing in favor. The future of the ammonia industry is therefore closely bound up with that of agriculture in this country.

Oil as a Metallurgical Fuel.

In a paper read by Mr. E. C. Felton, before the American Institute of Mining Engineers, the author reported the following as the result of experiments, made at the Pennsylvania Steel Works (Steelton, Pa.) in a series of trials, with oil as fuel in steel heating and open hearth steel furnaces:

First Trial.—Hot 14-in. ingots, six to a charge, were heated in two Siemens' heating furnaces in the blooming mill, the oil being put in first in March, 1888. The oil used had been partly refined, so that the paraffine and some of the naphtha were removed. During a run of six weeks the consumption of oil was about 6½ gallons per ton of blooms, including the oil required to keep the furnace hot over Sunday.

Second Trial.—The same partly refined oil was employed for melting in a 30-ton open hearth furnace, the charge being cold scrap and pig, with ore. Although the gas was carried from the producer to the furnace, a distance of about 300 ft., the oil consumption, as the average of a month's run, was 48 gallons per ton of ingots, including the oil required to keep the furnace hot over Sunday.

Third Trial.—Oil was introduced on June 11, 1888, to heat six Siemens' heating furnaces in the blooming mill, and has since then been constantly used. For a period of six months, including the fuel consumption on Sundays, and including the heating of some cold ingots, the consumption of Lima oil was 6 gallons per ton of blooms. The quantity of oil required naturally varies with the product of the mill. Under the most favorable circumstances—charging hot ingots and with all the stock supplied which the furnaces can handle—4½ to 5 gallons of oil are required per ton of blooms. Cold ingots must remain in the furnace for about three hours.

Fourth Trial.—Lima oil was used for heating a 30-ton open hearth furnace, the producer being located near it. As the average of a six weeks' run, 54 gallons of oil were required per ton of ingots, including

the fuel consumption over Sundays and for starting the furnace. The record of the first week was 46.7 gallons of Lima oil per ton of ingots. It was found that the loss is somewhat greater than with coal gas, and that some trouble was experienced from the fact that fine particles of oxidized iron clogged the checkers.

Fifth Trial.—Work in a 5-ton open hearth furnace, in use since December, developed a fuel consumption ranging between 50 and 55 gallons of oil per ton of ingots.

Sixth Trial.—Oil was applied to the raising of steam under two 100-horse power return flue tubular boilers, the temperature of the feed water being about 160° Fahrenheit. The results showed an average evaporation of about 12 lbs. of water per pound of oil, the best 12 hours' work being 16 lbs. of water evaporated per pound of oil. At the relative prices of oil and pea coal, the former is not as economical under boilers as the latter.

In all of the trials the oil was vaporized in the Archer producer, an apparatus for mixing oil and superheated steam, and heating the mixture to a high temperature. From 0.5 to 0.75 lb. of pea coal is used, per gallon of oil, in the producer itself.

The Problem of the Day.

The London *Journal*, in referring to the labor troubles now rampant in England, makes the following comment:

The labor troubles by which gas managers of the United Kingdom are now confronted, will have the effect of directing their attention once more to the possibilities of rendering gas production independent of trades union combinations. This can only be done in one way—by so utilizing machinery as to reduce to the minimum the dependence upon a plentiful supply of trained stokers, which is now shown to be one of the weak points of modern gas works administration. The Stokers' Union will result in improving the stoker off the face of the earth, if its wire pullers persist in pitting themselves against the mechanical resources of the age. They may flatter themselves that gas making is one of those branches of industry in which mechanism can only be applied to a limited extent for the substitution of hand labor; but this is an error. It is true that manual labor is still employed in the production of the bulk of the coal gas made in this country; but one reason for this is the indifference, if not the positive objection, that has often been displayed by gas managers and their superiors when proposals have been laid before them which would have the effect of radically changing the system of retort house working. When stokers gave no trouble beyond the ordinary ones incidental to all factories, gas managers were by no means anxious to be rid of them. Some take a kindly interest in their men, and enjoy the position of liberal employers of labor which the prosperity of gas undertakings permits them to occupy. Others have been averse to the unknown troubles and responsibilities attaching to the introduction of novel machinery. Others, again, have regarded proposals to substitute machinery for hand labor from the purely economical standpoint, and having failed to find sufficient inducement by way of probable saving of money, for reducing their retort house staff, have neglected machinery altogether. The very echo of the word "strike" is enough to change all this "let-alone" attitude into one of purposeful curiosity regarding automatic or mechanical methods of gas making; and this is therefore a good opportunity for looking over the resources actually at the command of gas managers, by recourse to which they may make themselves more independent of strikes and strikers, and at the same time for drawing attention to suggestions of the same character which have hitherto been neglected because of the lack of occasion to employ them. The question of mechanical gas production, in short, has been played with hitherto in places: but now it has become serious.

The first step in the direction of emancipation from the tyranny of the fireman has been taken by those gas managers who have adopted generator or regenerator firing; for this class of furnace is not so dependent upon trained manipulation for maintaining the heats in the settings as the old-fashioned direct-acting furnace. With an experienced foreman to look after the air inlets, any scratch labor can keep up better heats with a generator furnace than the most skillful—and consequently in too many instances the most unreliable—fireman of the old school with furnaces of the other kind. After the furnace comes the retort; and it is but natural that engineers should pause to ask themselves whether the mechanical stokers of the present type have, as a matter of fact, rendered them as independent of the human element as could be wished. We have some delicacy in discussing this point, because mechanical stoking at the present time, and in this country at least, means the West appliances in their different modifications—hand, steam, and compressed air. Without the slightest desire or intention to say anything derogatory of the West system, we do not hesitate to declare that it does not settle the stoking difficulty. If fewer men are required, they are still stokers, and must, as a matter of fact, be trained ones to work the West process to the best advantage. It is thus tolerably clear that escape from the labor difficulty can only be by two ways—either stoking, or rather we should say gas making, must be rendered so easy that any able-bodied laborer might manage it, or it must be effected wholly by automatic machines, the attendants on which might be mechanics or young engineers not belonging to the stoker class. It is the weakness, as well as the strength, of the West system, according to the standpoint of the observer, that it takes the gas retort as it is, without any attempt to improve it. To those engineers who think that horizontal retorts with comparatively light charges are the ultimate expression of gas making, the West system may appear perfect of its kind; but even this will not be admitted by others who compare the weight of the machinery with that of the human beings who do the same work. If the gas retort is to remain a small horizontal tube into which a few hundredweights of coal are put every four or six hours, and rather more than half the weight of coke is drawn at the same intervals, it is impossible to ignore the consideration that, weight for weight, the man is far and away the most efficient machine that has yet been applied to this purpose. If we must have heavy and complicated machines, by all means let us have something that will do for gas making what the self-binder reaper does in the harvest field; but this remains to seek.

Beyond the mechanical stoker comes the problem of modifying the dispositions of the retort setting itself—supposing, of course, that retort settings still retain something of their present character and are not done away with to make room for cupola gas generators of the Loomis or some allied type. The most obvious modification is that of inclining the retorts at such an angle from the horizontal as to combine the possibility of expansion of the coal under the influence of the heat—which can only take place in a retort that is horizontal, or nearly so—with that of discharging the coke automatically when formed. Two months ago we discussed this subject when reviewing the actual state of gas engineering; but no apology is needed for recurring to it, now that stoking has taken the most prominent place among gas makers' cares in a way that could hardly be foreseen even such a short time ago. The Coze system of inclined retorts has improved its position in the meanwhile, for Mr. Morris is about to try it on a sufficiently large scale at Southall; and as the Brentford Company are, after a fasion, experimentalists for the Gas Light and Coke Company, the arrangement may go further than Southall if Mr. Morris thinks well of it. We shall probably shortly publish some information relating to the Ludlow experiment in the same direction, which has been well spoken of by competent critics. Beyond these we know of nothing stirring in the same line; but now is the time for engineers having projects of the kind in their desks to bring them out and ask for opportunities for trying them. The last word has not been said upon mechanical gas making, with or without radical modification of the retort system; and any engineer who has a respectable project for disestablishing the stoker can be certain that now he will not be snubbed by his directors for mentioning it.

We believe that there is plenty of ingenuity available for this kind of application, provided that there is such a demand for it that perfection will not be expected to begin with. A great difficulty that inventors of gas-making processes have had to contend with in the past has been the narrowness of the margin of advantage for their schemes as compared with hand labor. So long as it was understood that hand stoking could be had at a reasonable figure the mechanician was loaded with the onus of proving his suggested improvements to be cheaper as well as better than the system which it was intended to supersede. No chance of imperfection was pardoned; and if the slightest alteration of the structure of retort house or any other building were needed, it was enough to condemn the project. Circumstances have arisen, however, to make the most routine gas manager in England understand how it is that a water gas generator, standing for the most part cold and unused in a corner of the retort house, is an unspeakable comfort to an American coal gas maker. There is no law to prevent British gas managers from following the same course, provided they keep up the quality of the output; and even this requirement would not trouble them to any great degree in places where the municipal authorities own the gas works, and make a pretence of checking the product.

It would be impossible to pretend to say what form the strife of machinery against labor combinations may take in the near future; whether it will be improved stoking machinery, modified retort settings, or the adoption of cupola gas generators. In any case, there is a call for the legitimate employment of capital and intellect to checkmate the arro-

gance of labor unions, directed for the most part by men who have their own purposes to serve in fanning the fued between employers and employed in the gas industry. It is not an occasion for the display of any feverish impatience for the acceptable solution. If this is coming at all, it will come in its own time, and cannot be hastened by the offer of prizes or any such device. The best assistance that can be rendered in a case of this kind is by the extension of a kindly, but at the same time judicious, welcome to inventive efforts. No good will follow from patronage of radically weak schemes, the failure of which on trial might strengthen the popular impression that manual labor must continue to be the rule in the gas making industry. All that we argue for is that wealthy gas companies and corporations should be at this time a little more open than has hitherto been their rule to provide opportunities for testing stoking devices aimed at the reduction of retort house labor. There may not be a great deal of money in these projects from an inventor's point of view, and therefore clever men may have thought that their ingenuity would meet with more reward in other fields. The matter touches an industrial and social reform of some magnitude, however, and should not be allowed to fall into neglect on account of the apparent smallness of the pecuniary reward for the man who should succeed in solving the problem. Gas stoking is not a particularly pleasant calling, perhaps, although there are many worse; and it would be a good thing to relieve men from the necessity of following it, especially when they show themselves so difficult to please in various respects. If, therefore, an inventor should propound to any gas manager a scheme for abolishing the gas stoker by means of a carbonizing process or retort serving machinery, he should be listened to, and if his plan recommends itself as workable and promising, it should be fairly tried. If not perfect at first, perfection may come with experience. A few months ago it would have been difficult to persuade the majority of gas directors to entertain an automatic gas making device; but times have changed, and policy must change with them.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the September meeting of the stockholders of the Danville (Ills.) Gas Light Company, Messrs. J. G. English, E. R. E. Kimbrough, C. J. Palmer, W. P. Chandler, and L. T. Palmer were elected Directors for the ensuing year. The Board subsequently organized by naming W. P. Chandler to the Presidency, Mr. J. H. Woodmansee being again chosen Secretary and Treasurer. It pleases us greatly to add that the new Board celebrated their induction to office by making the announcement that hereafter the following schedule of rates would rule:

Monthly Consumption	Net Rate.
Under 500 cubic feet	$2 00 per 1,000.
500 to 3,000 cubic feet	1.60 "
3,000 to 10,000 cubic feet	1.50 "
10,000 cubic feet and upward	1.40 "

The works are sending out gas of from 20 to 22 candle power, Illinois native coals being carbureted, while crude oil is used as the enricher. Gas of that quality, at $1.40 per thousand, it seems to us will put the Danville Company soon in the position where it will have to call for figures on plant extensions. That fact, however, will not cause the proprietors any uneasiness.

About a fortnight ago Ald. Wolf, of Milwaukee, Wis., introduced a resolution in the Board to light the public lights "as soon as it is getting dark." The resolution was adopted.

We understand that the United Gas Improvement Company will in all likelihood secure control in the Minneapolis (Minn.) Gas Light Company.

Mr. Carr, Engineer of the Widnes (England) Local Board, which controls the gas plant of that city, writing under date of Sept. 30, made the following report to his Committee respecting the latest results with the Dinsmore process: "The new bed in No. 2 house continues to give good results. Two weeks' working with Abram Arley mine slack gave the following: Gas made per ton of coal, 11,300 cu. feet; illuminating power (average) 20.74 candles; tar used per ton of coal carbonized, 4½ gals. The alteration of taking the tar into the duct in a gaseous instead of a liquid form simplifies both the plant and the working operation. No extra care or attention is required over the ordinary stoker's duties. There are at present two beds working on this system. Two more are to be started in October and a like addition in November. When these shall have been completed 41 mouthpieces will be working in Widnes on the Dinsmore plan.

On the 1st inst. President Smart, of the Port Hope (Can.) Gas Company, notified the residents that hereafter the net selling rate would rule at $2 per thousand. This is in accordance with the Company's promise of a year or so ago that as soon as the rate of consumption that followed the cut then made would justify it the price would again be reduced. Six years ago the selling rate was $3 per thousand; the next cut brought it to $2.50; and now it is at $2. We congratulate President Smart and the proprietors on their latest move, which is sure to bring them profit and popularity.

The transfer of the electric lighting plant at Portsmouth, N. H., to the gas works site has caused some interruption to the service, but those who have been temporarily inconvenienced thereby will soon have reason to congratulate themselves over a perfect service when "things get to working smoothly."

Mr. E. B. Sammis, who for years has been the popular ticket agent of the Consolidated Railroad Company's lines at Bridgeport, Conn., will, on Nov. 10, formally assume the duties of Treasurer of the Bridgeport Gas Light Company. We welcome him to the ranks.

We understand that Mr. C. H. Simpkins has disposed of his interest in the Los Angeles (Cal.) Gas Company to the Pacific Lighting Company. In any event, we note that at a recent meeting of the Company Mr. W. B. Klein—who is President of the Pacific Lighting Company—had been elected President of the Los Angeles Company, and that the other Directors selected comprised Messrs. W. N. Van Dyke, H. W. Garrettson, I. W. Hellman, and L. C. Goodwin. Mr. Goodwin is to act as Vice-President, and J. P. Neuhart will serve as Secretary and Treasurer. The latter gentleman has been connected with the fortunes of the Company for many years, and we are pleased to note that he is still to be prominent in its management. The new proprietors will expend a goodly sum in plant extensions, which are to be arranged for at once. While we are sorry to note the retirement of Mr. Simpkins from the Los Angeles gas field, we are pleased that the property which he guarded so jealously has fallen into strong hands.

The Town Council of Ingersoll, Canada, has been trying for something like two years to make up its mind as to who should have the right to illuminate the streets by means of electricity; and it seems now as though a decision had been reached. Among the bidders was the Ingersoll Gas Light Company, whose proprietors announced their willingness to furnish 9 arcs (2,000 candle power each) and 100 incandescents (30 candle power each) on the basis of an annual payment of $1,650 for the service—the lights are to burn on 300 nights of the year, until midnight. This proposition was accepted, the contract to be for 3 years, with the privilege of 5.

The present proprietors of the Dansville (N. Y.) Gas Light Company have determined to make a virtual reconstruction of the plant at that point. This is a step that should have been taken long ago; but "'tis better late than never."

The sale of the Council Bluffs (Iowa) Electric Light and Power Company is reported. The purchasers are the Sperry Electric Light and Gas Company, of Chicago, who are said to have paid $65,000 for the property and franchises thus acquired. If that was the consideration the old Company ought to have made a handsome figure on the "deal."

Some time ago we reported the passage by the Boston Board of Aldermen of a resolution appointing a committee to be charged with the duty of "investigating the methods of manufacturing gas practiced by the Boston Gas Company." The committee who are to make the "investigation" are Messrs. Moore, Brown, Doherty, Lovett and Cannon, not one of whom—at least so our correspondent affirms, and he usually "knows what he is talking about"—has any knowledge of the subject that is to be "investigated."

Judge Bradley, in his opinion in the case known as "The Consolidated Electric Light Company" (Westinghouse) vs. "The McKeesport Light Company" (which was using the Edison lamp), dismisses the bill brought by plaintiff for infringement of the patent for fibrous carbon filaments in incandescent lamps. He says: * * * "We are clearly of the opinion, therefore, that neither Sawyer & Man nor Edison can maintain any just claim to the exclusive use of charcoal generally in any form as an incandescing conductor in an electric lamp."

The La Grange (Ills.) Water and Light Company has been incorporated by Messrs. Samuel A. Moffat, and J. L. and R. B. Hotchkin. It is capitalized in $125,000, and proposes to supply water and light in the district named.

Mr. Lincoln Hammett has taken service with the gas company at Warren, R. I.

WHILE not in position to so state with absolute certainty, it is nevertheless within the range of possibilities that the proprietors of the Consumers Gas Company, of Toronto, Canada, are about to make another reduction in gas rates. In view of the action of the authorities on the Company's application for the right to supply electricity under conditions similar to those granted to its rivals, we take it that the proposed cut in gas rates looks a bit like returning good for evil. It is hard, however, to make your average Canadian feel that he is being punished when he is thus treated. He is not over-sensitive, particularly when clad with authority. Come to think of it, the average American exhibits similar symptoms.

ACCORDING to the bids submitted in response to the invitation of the Buffalo (N. Y.) authorities for tenders for the public lighting, we note that the local gas companies agree to supply gas to the city for $1.25 per 1,000 cubic feet—a reduction of 5 cents per 1,000 over the present rate. The bids submitted by the electric light companies (the Brush, United States, and Thomson-Houston) are uniform at 42½ cents per arc per night. This, we believe, is a concession of 5 cents per arc from the ruling rate. The Buffalo authorities seem to be under the impression that the electric light proprietors are reaping large profits from their business, but the fact is that any one of the named companies is perfectly willing to sell out its plant to the authorities.

THE projectors of the Hyde Park (Chicago) new Gas Company have, in deference to public opinion, about agreed to purchase another site for the location of their plant. Stewart avenue and 43d street may be the corner eventually chosen.

ACTING under the authority of the United Gas Improvement Company, Mr. Robt. M. Searle, Superintendent of the Sag Harbor (L. I.) Gas Company, has published the following notice of a reduction in gas rates, the same to affect all gas supplied from and after the 1st inst.:

Monthly Consumption.		Rate per 1,000.
Under 1,000	cubic feet	$3.00
1,100 to 1,500	"	2.90
1,600 to 2,000	"	2.80
2,100 to 3,000	"	2.60
3,100 to 5,000	"	2.50
Over 5,000	"	2.25

Those conversant with the conditions governing the gas supply of Sag Harbor will concede the fairness of the schedule.

THE residents of Rochester (Minn.) are very much pleased with the quality of the gas served in the lamps that now light the business portion of that city. It is natural to suppose that the change from oil lamps to gas lamps would be appreciated, even in Rochester.

THE proprietors of the Dalton (Ga.) Gas Company hope to be able to put their electrical annex into operation by November 1st.

THE Appleton (Wis.) Council proposes to grant a franchise to the projectors of the Fuel Gas Company for that city, provided the following conditions are complied with: The Company must give a bond in $10,000 to the city, renewable every five years, to hold the city harmless in case of accident arising to anybody from the operation of the works and in case of suit being instituted against the city by the Appleton Gas Light Company; also, that before the streets may be opened the Company must obtain permission from the Mayor and the Street Committee, which permission must subsequently be ratified by a two-thirds vote in the Council.

THE Allegheny County (Pittsburg, Pa.) Electric Light Company's boiler system is fired with natural gas, and of late the shortage in supply of this fuel has caused much inconvenience. The Company is under contract to furnish a goodly portion of the public lighting, and on several occasions the circuits to certain sections had to be temporarily suspended. On the 9th inst., what are known as the Fifth avenue and Sixth street circuits were in darkness for over half an hour, and Chief Engineer Smith, when appealed to for a reason for the failure, said: "The trouble was lack of gas to propel our engines. We have been short of gas for six days, and even now you will find coal and wood under some of our boilers. What is the cause? Ask the Natural Gas Company, who say it is owing to the fact that they are putting in a 36-inch supply main. I, however, have my own opinion as to the trouble. About 6 P. M. many of the mills shut down, and it is necessary to reduce the pressure. At 6.30 the mills start up on the night shift, and it is impossible to get sufficient pressure in the short time allowed to keep everybody going. It is now 7.30, and we have sufficient gas to keep us going to-night. How it will be to-morrow, next day, or next week, I cannot tell. We will have an abundant supply of coal on hand hereafter, and our patrons may feel assured that they will not be without light very long at one time. We keep our engines going on gas as long as we can, and when there is not sufficient steam to run them all, we stop them—one at a time—until the steam comes up again, and then we are all right. I suppose we received over 200 complaints to-night, and we could not very well blame our customers for making objection."

THE lighting of the Terni Steel Works (foreign) which cover an area of nearly 48 acres, is performed by 100 arc and 1,200 incandescence lamps. The arc lamps are fixed on posts 33 feet in height; and there are in all 40 arc light circuits. The incandescence lamps are of high candle power, and a certain number of them are movable. The current is supplied to the arc light circuits by 12 dynamos of 10-horse power each, which are driven by turbines. For the incandescent lighting two dynamos, each of 75-horse power, are employed, also worked by turbines.

AT the present time Watertown (N. Y.) is being lighted by means o. 108 high candle power arcs, which are lighted from dark until midnight on 20 nights of each month, the payment therefor being at the rate of $68 per lamp per annum. The service, however, has been so unsatisfactory that it is proposed from and after January 1, 1890, to light the lamps each night and all night, the payment therefor to be at the rate of $102 per lamp per annum.

AT a meeting of the Philadelphia Councils Committee on Gas a report from the sub-committee (appointed some time ago to investigate the merits of the Toraya process of gas making) was read. The findings were favorable to the process mentioned, the proprietors of which guaranteed to furnish a gas of not less than 25-candle power at a cost not to exceed 45 cents per 1,000 cubic feet. The report will be discussed at a subsequent regular stated meeting of Councils.

LAST week we printed a wail from Boston over the large amounts that the mischievous small boy caused that city to pay in the shape of renewals of glass to the public lamps. While similar complaints come from every city, the authorities ought to be able to confine the cost within reasonable limits. For instance, a correspondent writes that the practice in East Orange, N. J., is to offer a reward for information that will lead to the apprehension of anyone caught in the act of breaking a street lamp glass. If the "small boy's" father knows that he is in for a fine of $10 in case his young hopeful is detected in the playful act of smashing a lamp glass, the aforesaid parent may be counted on to have but one "experience" of the sort noted.

THE following (from the Wilmington, Del., *News*) is given for what it is worth: "The scene at the new gas plant of J. Edward Addicks on the marsh back of the Harlan & Hollingsworth Company's works is a busy one. Over 100 mechanics are busily at work in their different branches. The large force of mechanics is under the direct supervision of Engineer S. B. Conde, who is doing everything possible towards the early completion of the building. Mr. Addicks expects to have the entire works completed and in working order by next October. The plans for the mammoth gas tanks were completed last week and were forwarded to this city yesterday for the inspection of Engineer Conde. The plans show three gas tanks and four buildings, with several small buildings to be used for minor purposes. The largest tank, to be known as the "jumbo tank," will be the largest affair of the kind ever erected in the State. It will be 200 feet in diameter and over 100 feet high. The well will be 32 feet deep, and work will be commenced in a few days. There will be two smaller tanks, one to be used to hold fuel gas and the other for receiving the gas for illuminating purposes before it is purified. The size of these two tanks has not yet been decided upon. They will be made by Bartlett, Hayward & Company, of Baltimore. The purifying house will be built of brick, and will be 40 by 105 feet in size. It will have iron roof and floor, and will be of an improved design. Mr. Addicks is negotiating with the Edge Moor Iron Works for furnishing the materials for the building."

"MANY of your readers, particularly those living east of the New York State line, will be surprised to hear that Captain L. N. Van Keuren, who had been Secretary and Treasurer of the Bridgeport (Conn.) Gas Light Company for a number of years, is not now in the service of that Company. On the 1st of September his resignation was handed to the Board of Directors, and the latter accepted it; not, however, without inscribing on the minute book a most complimentary resolution re-

specting the manner in which the retiring officer had conducted the business of the Company. It is all very well to pass complimentary resolutions, and no doubt the resolutions adopted in this instance were appreciated by Mr. Van Keuren, but it is strange, to say the least, that the Bridgeport Gas Company could agree to part with a man of Mr. Van Keuren's capacity, who leaves its service to assume another responsible charge in the shape of the management of the local banking enterprise controlled by Messrs. T. L. Watson & Co. Without mincing matters, it seems to me that the Gas Company could have arranged it so that Mr. Van Keuren would yet be a fixture in its office. Speaking personally, I wish to give expression to my regret at the change thus brought about. In the meantime, however, it is only fair to state that Mr. Van Keuren's successor—who was chosen at a special meeting of the Board held on the 8th inst.—Mr. Frank B. Sammis, is about as popular a man as Bridgeport holds to-day. His long-time connection with the passenger service of the Consolidated Railroad at this point has caused him to be on familiar terms with the citizens, who like him very well. His training at the ticket window ought to serve him in good stead now that he is likely to be confronted frequently by the 'indignant gas consumer,' who, I am sorry to add, is often found in the Nutmeg State.—HADDAM."

THE Haverhill Gas Light Company's supply system has been greatly improved by the placing of a 16-inch leading main from the holders.

THE proprietors of the Lynn (Mass.) Gas Company are about to make arrangements for largely increasing their sales in the outlying town of East Saugus.

AT the October term of the United States Circuit Court, held in Concord, N. H., on the 9th inst., Judge Le Baron B. Colt, of Bristol, R. I., presiding, the first case called was that of the United Gas Improvement Company versus the Manchester (N. H.) Gas Light Company. It was specially assigned to the date named from the Portsmouth term, last May. The case is a suit for damages on account of an alleged breach of contract, the plaintiffs claiming that defendants having authorized them to construct a gas plant of a certain type, subsequently refused to accept the same. When the case was called plaintiffs asked for a continuance, on the ground that their principal witness—Mr. A. O. Granger—was unable to be present. The Hon. Jno. M. Mitchell argued for plaintiffs' petition. The motion was opposed by District Attorney J. H. S. Frink, for the defendants, who said that in addition to the fact that the case was set especially for this term, for the express purpose of giving plaintiffs ample time to produce their witnesses, the defence was further entitled to an immediate trial on account of the advanced years of some of the principal members of the defendant Company. They, being respected members of the community in which they resided, naturally wished that this case, in which they were charged with breach of contract, should be settled during their lifetimes, and that no unnecessary delay should be allowed. The case was continued until the May term.

"AN adjourned meeting of the Brockton (Mass.) Gas Light Company was held in Boston on the 11th inst., with Mr. W. S. Eaton in the chair. The old Board of Directors tendered their resignations, which were accepted. The reason for this action is found in the fact that 400 shares out of the 640 in the Company were purchased by Boston capitalists, who are said to have paid 110 for the stock. The Directors elected were Messrs. Malcolm B. Peters, W. S. Eaton, J. W. Whitmarsh, R. H. Gorham, and H. D. Reed. Treasurer Sanford will remain as Treasurer. The Company was formed in 1857 by Messrs. H. W. Robinson, Noah Chessman, J. R. Perkins, David F. Studley, and W. F. Brett, who for several years applied the earnings to plant betterments. Latterly, however, dividends at the rate of 7 per cent. per annum were declared, but the plant meanwhile suffered from the parsimony of those in charge. The new owners will increase the capital, and apply the money thus acquired to putting the works in good order. In fact, as I understand it, the plant will be reconstructed on an enlarged scale.—OBSERVER."

THE Dover (N. H.) plant of the Somersworth Machine Company has been leased for a term of 3 years by the proprietors of the Forward Gas Engine Company. It is their intention to push the sale of this engine under the rights recently acquired by purchase from the owners of the English patents.

THOMAS J. GILCOYNE, who for over 20 years has served in the capacity of Collector for the Troy (N. Y.) Gas Light Company, died on the 12th inst.

WHEN the Committee (appointed to draw up a platform at the recent meeting of the Democratic State Convention) was considering what "planks" would be available to float the "independent vote," one of the members suggested that a clause favoring the granting to cities and towns of authority "to supply to their citizens water, electric lights, and gas, and to render them such other public services as are now delegated to individuals and private corporations," would be likely to catch the public fancy. The proposition provoked an extended argument, but it was negatived on the ground that it would savor of an endorsement of the "nationalist movement."

THE suit of William Allport against the Medina (N. Y.) Gas Company for damages to person resulting from a gas explosion resulted in a verdict of $4,000 for the plaintiff.

THE storage sheds of the Jamaica Plain (Mass.) Gas Company were slightly damaged by fire on the afternoon of the 13th inst.

THERE was an annoying interruption of the gas supply to Haverhill, Mass., and the adjoining village of Bradford, on the evening of October 11. The interruption, which lasted for something over an hour, was occasioned by the negligence of the foreman in charge of certain main extensions now being carried out by the Company.

THE annual meeting of the Consumers Gas Company, Toronto, Canada, will be held at noon, Monday next. It is probable that at this meeting a reduction in gas rates will be arranged for.

MESSRS. SMITH & WATSON have petitioned the authorities of Watsonville, Cal., for an electric light franchise. If a favorable return is made, they will install a plant equal to the maintenance of 500 incandescent lamps of 16-candle power each, the monthly charge for each lamp (all night service) to be $1.50. Water power is to be employed, which we presume will be derived from the Pajaro river.

THE electrical annex of the Rockville (Conn.) Gas Company is to derive its power from two Otto gas engines, of 40-horse power each, and it is presumed that the lights will be turned on about December 15. The buildings are very handsome structures, and the plant is to be in keeping with its housing.

MR. SAMUEL B. HUEY, attorney for the Brooks Process Gas Company, of Philadelphia, has made a proposition to the Joint Councils Committee on Gas, in which he states that the Company will "furnish 24-candle power illuminating gas to the city at 35 cents per 1,000 cubic feet net in the holder, and to furnish the gas in any quantity desired." As we understand it the Brooks process has been operated for 1½ years at Downington, Pa., with, it is said, perfect satisfaction to those who use the gas.

THE proprietors of the Montpelier (Vt.) Gas Company are reported to be very much pleased with the results so far obtained from the Peter English type of gas plant installed by them some months ago.

THE Philadelphia *Record* says: "'Curbstoning,' or the art of reading a gas meter by guess from a position on the curbstone, instead of exploring the depths of a musty cellar, has been revived in the Gas Bureau. Director Wagner has taken prompt steps to stop the practice, however, by summarily dismissing the meter inspector who was detected in making out gas bills in this novel manner. Since the palmy days of the old Gas Trust 'curbstoning' has been regarded as a lost art. This is the first case of 'curbstoning' detected in four years, and the culprit was caught by Inspector Lang. A month ago complaints began to pour into the Gas Bureau from Kensington to Southwark protesting against the excessive figures of the gas bills. Inspector Lang took the matter in charge, and soon had cause to suspect an inspector who had charge of seven sets of books. A proper registration of the complainants' gas meters was made and the inspector's books were examined. When the proof of the inspector's guilt was collected the matter was reported to Director Wagner on September 14th. He summoned the inspector and promptly discharged him. Most of the 'curbstoning' was done at the expense of the consumer, but in a few instances the city was the loser. Correct bills have been sent to all the victims by order of Director Wagner. 'Curbstoning' was a fine art several years ago, when gas was $3 per 1,000 cubic feet, and before the inspectors wore the blue uniform. The exceedingly lax methods of the Gas Trust made the operation easy, and the culprits were seldom detected. 'Curbstoning' does not put money in the inspector's pocket; it simply enables him to loaf at the city's expense instead of exploring coal bins and cobwebbed cellars in search of a meter. The 'curbstoner' does his work on the inspecting tours by putting in the book such figures as he may think will properly represent the amount of gas consumed."

The Market for Gas Securities.

The easier rates for money have caused an advance in almost all classes of securities on the Exchange, and Consolidated gas was not slow to respond to the upward movement. On Thursday it sold up to 91¼, but reacted somewhat. To-day (18th) it is at 90¼, and the prospect for a sharp advance seems bright.

Other city shares are held at better figures.

In Brooklyn no particular change is to be reported, although any difference in bid price over those previously noted is in favor of the holder.

The Laclede Company's new securities are to be listed on the New York Exchange.

Some inquiry for Boston gas (common stock) was made early this week.

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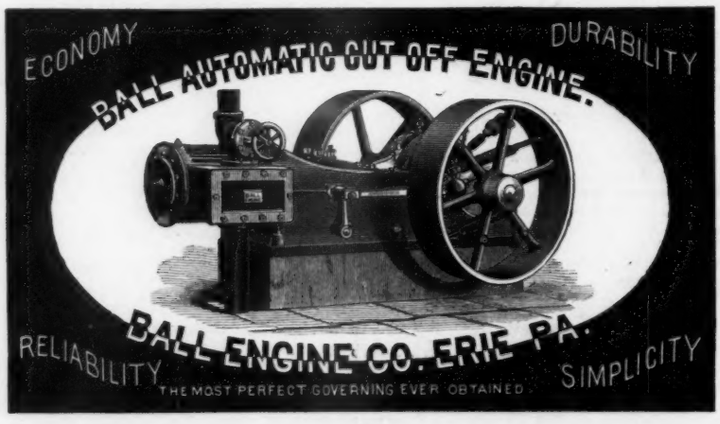

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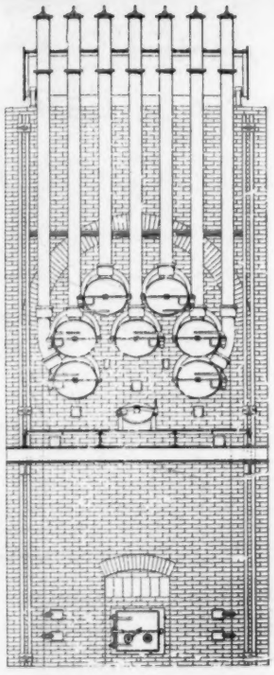

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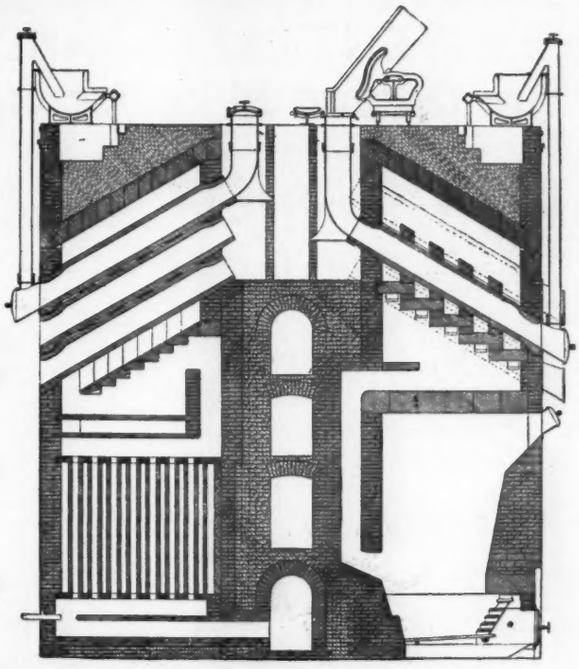

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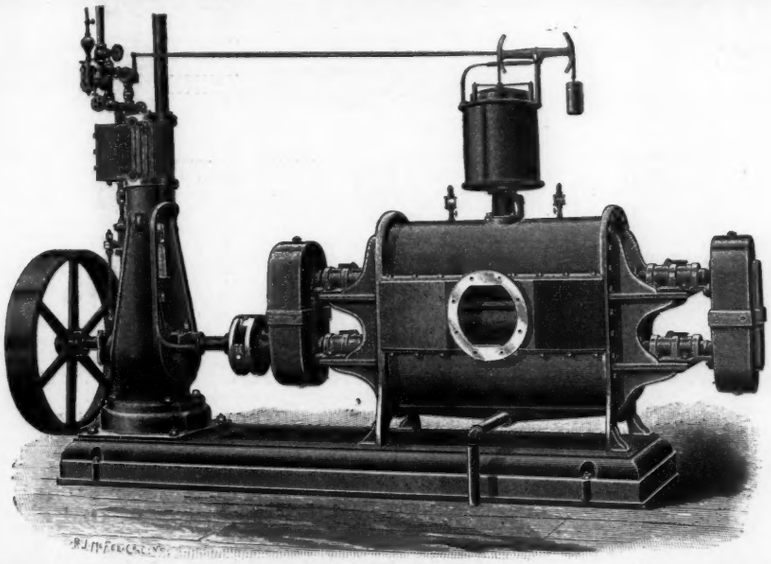

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"	1,250,000
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Enfield	300,000
Essen	300,000
Elbing	150,000
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Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
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Guildford	300,000
Gloucester	1,250,000
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Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A.	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A.	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A.	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A.	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A.	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A.	680,000
Northfleet	200,000
New York, U.S.A.	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W.	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A.	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A.	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A.	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A.	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A.	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A.	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A.	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A.	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A.	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A.	750,000
Yeadon	500,000
Yeovil	250,000

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Wellington Light & Heat Co.	Wellington, Kansas.
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South Bend Gas Light Co.	South Bend, Ind.
Sheboygan National Gas Co.	Sheboygan, Wis.
Salina Gas Light Co.	Salina, Kansas.
The Rathbun Co	Deseronto, Prov. Ont.
Jefferson City Gas Lt. Co	Jefferson City, Mo.
Mankato Gas Light Co.	Mankato, Minn.
Lima Gas Light Co.	Lima, Ohio.
Minneapolis Gas Light and Coke Co.	Minneapolis, Minn.
Bellevue Water and Fuel Gas Light Co.	Bellevue, Campbell County, Ky.
Bucyrus Gas Lt. & Fuel Co.	Bucyrus, Ohio.
Morris Gas Co.	Morris, Ill.
Los Angeles Gas Co.	Los Angeles, Cal.
San Diego Gas Fuel & Electric Lt. Co	San Diego, Cal.
Sioux Falls Gas Co.	Sioux Falls, Dak.
Dakota Gas and Fuel Co.	Grand Forks, Dak.
St. Johns Mutual Gas Co.	St. Johns, Mich.
Stillwater Gas Light Co.	Stillwater, Minn.
St. Paul Gas Light Co	St. Paul, Minn.
Emporia Electric and Gas Light Co.	Emporia, Kas.
Van Wert Gas Light Co.	Van Wert, Ohio.
Lansing Gas Light Co.	Lansing, Mich.
San Francisco Gas Lt. Co.	San Francisco, Cal.
Shelbyville Gas Light Co.	Shelbyville, Ind.
Great Falls Gas Light Co.	Great Falls, N. H.
Belleville Gas Co.	Belleville, Ontario
Rochester Lt. and Fuel Co.	Rochester, Minn.
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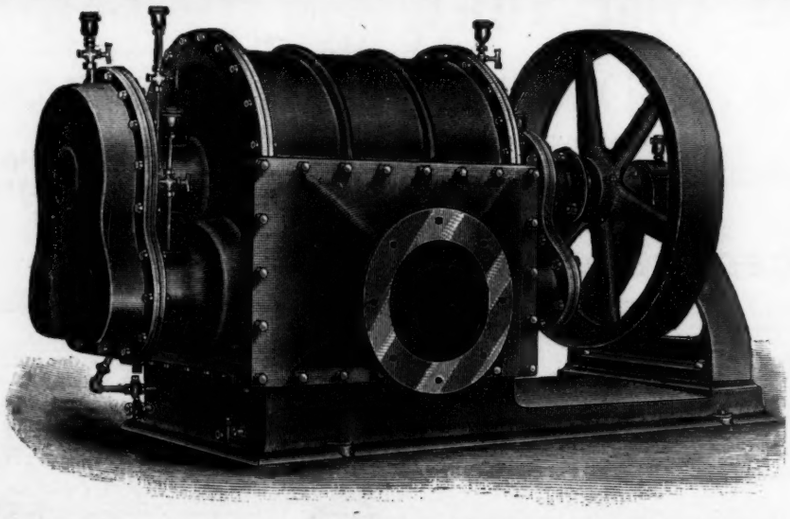

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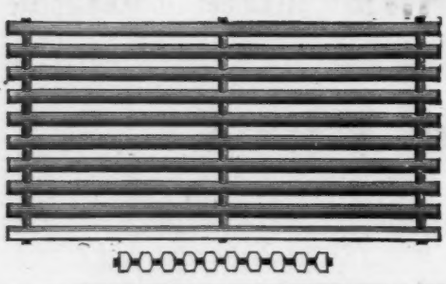

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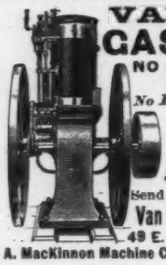

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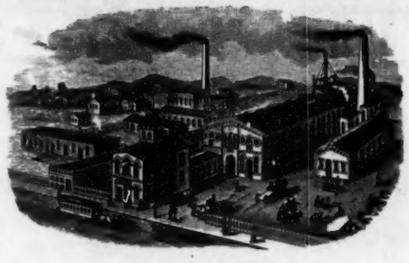

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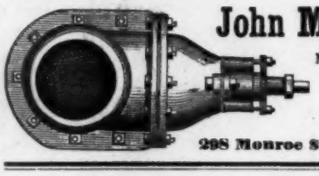

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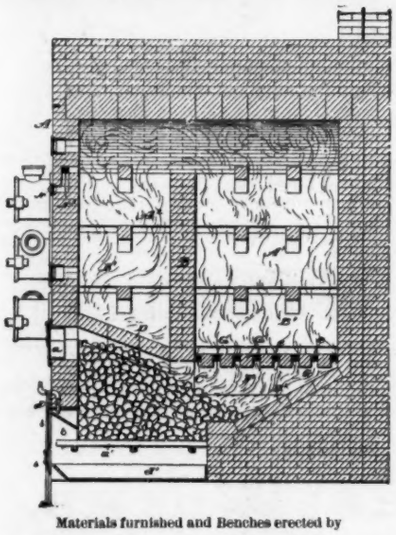

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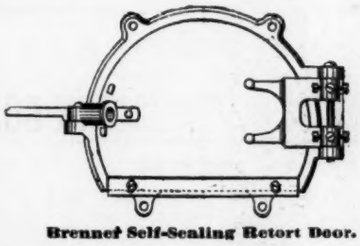

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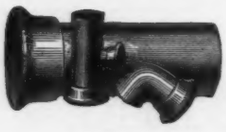

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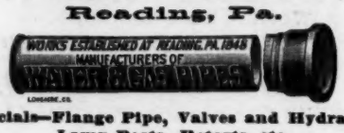

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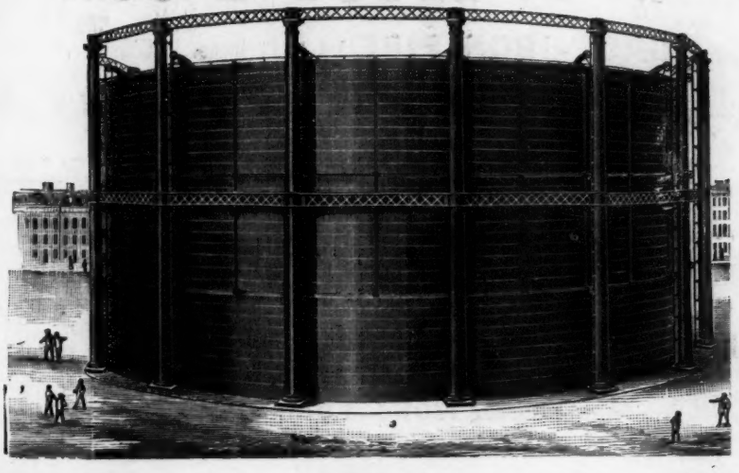

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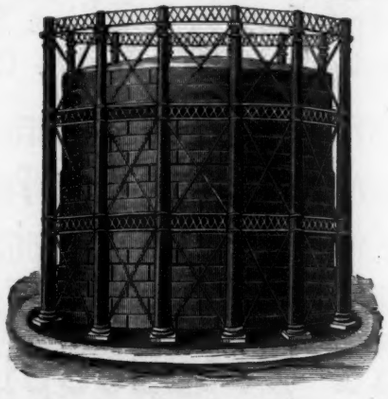

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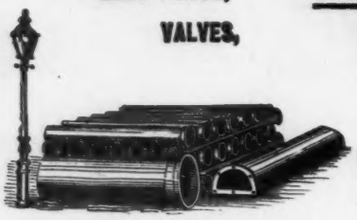

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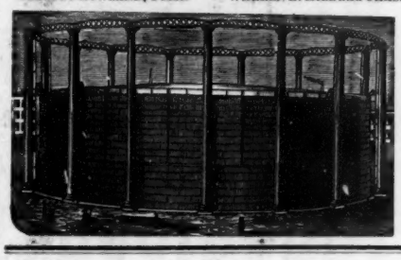

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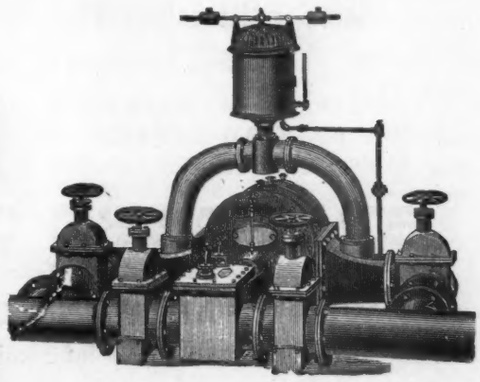

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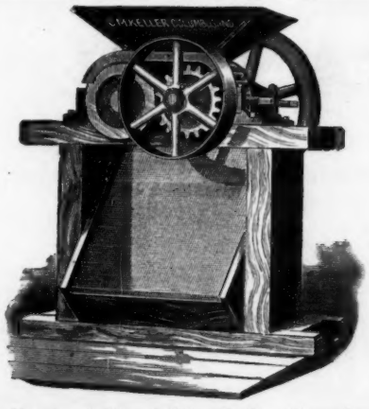

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50-H.P. STEAM ENGINE AND BOILER, Running a Plant of Fifty 2000-C.P. Arc Lamps 12 Hours.	
4,500 lbs. Indiana nut and slack, at $1.30 per ton	$2 93
Engineer, one night, at $50 per month	1 67
Trimmer, one day, at $40 per month	1 33
Superintendent or Electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent, one day, at $40 per year	11
Wheeling coal and removing ashes, at $4 per week	58
100 pairs carbons, at $18.50 per 1000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$10 38

50-H.P. OTTO GAS ENGINE, Running a Plant of Fifty 2000 C.P. Arc Lamps 12 Hours.	
9,200 cu. ft. gas, at 42 cts. per M. (for cost of gas see items below)	$3 86
Engineer not needed; engine is in care of Electrician or Supt.	....
Trimmer, one day, at $40 per month	1 33
Superintendent or electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent dispensed with (cooling water used over and over)	....
Handling of coal included in cost of gas	....
100 pairs carbons, at $18.50 per 1,000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$8 95

Expenses of depreciation, repairs, and interest omitted, being considered the same in both cases—though depreciation and repairs are much higher with steam on account of boiler and its appurtenances. Cost of gas in the holder we estimate for most of the Middle and Western States as follows: Coal, 30 cts.; labor, 20 cts.; purification, 2 cts.; total, 52 cts. Less coke, 7 cts., and tar, 3 cts.; leaving net cost of gas 42 cts. The items of Superintendence and repairs, being paid for by the gas sold to consumers, need not be charged on extra output for gas engine consumption. Where the cost of gas is higher than here figured, coal for steam use will be found proportionally higher, and final figures of comparison show same amount of saving.

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